

United States Patent and Trademark Office

Application No.: 10/613,513
Confirmation No.: 4790
Filed: July 3, 2003
First Named Inventor: Brian Y. Lim
Title: Apparatus and Method for Fabrication of Nanostructures Using
Multiple Prongs of Radiating Energy
Examiner: Maria Alexandra Elve
Art Unit: 1725
Customer No.: 51111
Docket No.: ATOMP001

Commissioner for Patents
POB 1450
Alexandria, VA 22313-1450

Reply Brief

Dear Commissioner:

This is a reply brief in support of an appeal from the nonfinal office action mailed March 20, 2009 and is in response to the examiner's answer mailed February 4, 2010. The following items are included in this brief:

Status of Claims starts on page 2.

Grounds of Rejection to Be Reviewed on Appeal starts on page 3.

Argument starts on page 4.

Status of Claims

Claims 1–18 and 29–55 are pending in this application. Claims 19–28 have been canceled.

Claims 1–18 and 29–55 are rejected and the subject of this appeal.

A claims appendix to the appeal brief filed November 5, 2009 contains a listing of the pending claims.

Grounds of Rejection to Be Reviewed on Appeal

I. A first ground of rejection to be reviewed on appeal involves whether claims 8 and 9 are under 35 U.S.C. § 112, second paragraph, unpatentable as being indefinite for failing to particularly point out and distinctly claim the subject matter which appellants regard as the invention.

II. A second ground of rejection (double patenting) has been withdrawn by the examiner.

III. A third ground of rejection to be reviewed on appeal involves whether claims 1–3, 6–7, 9, 11–14, and 18 are under 35 U.S.C. § 103(a) unpatentable over U.S. patent 6,756,026 (Colbert) in view of PCT application publication WO02/081366 (Dai).

IV. A fourth ground of rejection to be reviewed on appeal involves whether claims 4–5 and 10 are under 35 U.S.C. § 103(a) unpatentable over U.S. patent 6,756,026 (Colbert) in view of PCT application publication WO02/081366 (Dai), and further in view of U.S. patent 6,801,350 (Glasner-Inbari).

V. A fifth ground of rejection to be reviewed on appeal involves whether claims 15–17 and 29–46 are under 35 U.S.C. § 103(a) unpatentable over U.S. patent 6,756,026 (Colbert) in view of PCT application publication WO02/081366 (Dai), and further in view of U.S. patent application publication 2002/0127170 (Hong).

VI. A sixth ground of rejection to be reviewed on appeal involves whether claims 47–49 and 52–55 are under 35 U.S.C. § 103(a) unpatentable over U.S. patent 6,756,026 (Colbert), PCT application publication WO02/081366 (Dai), and U.S. patent application publication 2002/027170 (Hong) in view U.S. patent 6,801,350 (Glasner-Inbari).

VII. A seventh ground of rejection to be viewed on appeal involves whether claims 50 and 51 are under 35 U.S.C. § 103(a) unpatentable over U.S. patent 6,756,026 (Colbert), PCT application publication WO02/081366 (Dai), and U.S. patent application publication 2002/0127170 (Hong) in view U.S. patent 6,683,783 (Smalley).

Argument

The examiner continues to reject the claims based on the same rationale as stated in the record and also based on the modified rationale as stated in the examiner's answer. The appellants continue to disagree with the examiner's rejections and stand behind the arguments made in the appeal brief filed November 5, 2009, and elsewhere in the record. Appellants continue to believe that the rejections are improper.

This reply brief provides some further discussion and clarification on specific points in support of this appeal.

Pages 3 and 8-9 of Examiner's Answer (I)

Appellants submit that claims 8 and 9 are definite, and one of ordinary skill in the art would understand the subject matter claimed in these claims.

Regarding claim 8, on page 2 of the examiner's answer, the examiner states that "it is not clear how a set of islands of catalyst can be associated with one die. Is the die very large, are the catalyst areas scattered about?" On page 9 of the examiner's answer, the examiner further states that "claim 1 states that each die has catalyst on it and having a catalyst cannot be a set of islands of catalyst (as stated in claim 8); it may be, however, in the form of a set of islands." (Emphasis added by the examiner).

The examiner appears to be confused about the size of a die or the amount or form of catalyst present on the die. The examiner also appears to be suggesting that the claim would be definite if the phrase "in the form" precedes the phrase "a set of islands."

Appellants respectfully disagree. While appellants appreciate the examiner's suggestion, appellants believe that the addition of the phrase "in the form" would not be appropriate in the claim. Claim 8 recites that "a set of islands of catalyst irradiated in a first irradiating period is not identical to a set of islands of catalyst irradiated in a second irradiating period." The phrase "a set of islands" as recited in the claim does not mean that the catalyst exists in the form of a set of islands on a die. Rather, it refers to multiple catalyst loci which are heated by multiple prongs of radiating energy. See also paragraph 23 of the specification.

Regarding claim 9, on page 9 of the examiner's answer, the examiner states that "claim 9 states all catalyst throughout the die. It is not known how catalyst is present in the die, for

example, is the catalyst present through the entire body of the die. Claim 1 states that the catalyst is present on the die and not throughout the die.”

Appellants respectfully submit there is nothing inconsistent about the way claims 1 and 9 are drafted. Claim 1 states that each die has a catalyst on it, and the subject matter claimed in claim 1 is not limited by how catalyst is present in the die. For example, the catalyst can be present at the center of the die, on the corners of the die, or throughout the die. Regardless of how the catalyst is present in the die, claim 9 states that “all catalyst throughout die that are desired for seeding growth are irradiated” by positioning and aligning multiple prongs of radiating energy.

Appellants believe that claims 8 and 9 are definite, and the rejection of the claims is improper.

Page 9 of Examiner’s Answer (grouping of III.1 and III.2)

The examiner disagrees with appellants’ grouping of claims into Group III.1 (claims 1–3, 6–7, 9, 13–14, and 18) and Group III.2 (claims 11–12). The examiner states that both groups of claims stand or fall together, because claims 11 and 12 depend on claim 1.

Appellants respectfully disagree. According to 37 C.F.R. § 1.965(c)(7), for each ground of rejection which applies to a group of two or more claims, appellants can provide a statement whether the claims of the group do not stand or fall together, as long as appellants explains why the claims of this group are believed to be separately patentable. Appellants have met this requirement on pages 5 and 9 of the appeal brief filed November 5, 2009. Contrary to the examiner’s assertion, there is no requirement that dependent claims must always stand or fall together with their independent claims.

Pages 9–12 of Examiner’s Answer (III.1)

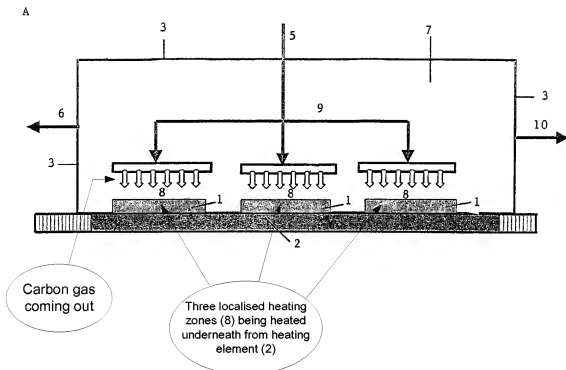
For III.1, claims 1–3, 6–7, 9, 11–14, and 18, directly or indirectly, depend upon claim 1. Claim 1 recites, *inter alia*, heating catalyst on at least one die “via simultaneously emitted multiple prongs of radiating energy.”

In the office action dated March 20, 2009, the examiner includes figure 1B of Dai in the office action, and states that Dai shows “localized heating zones (8) with multiple heating prongs or laser beam prongs.” The examiner then concludes that it would have been obvious to one of

ordinary skill in the art at the time of the invention to modify Colbert to use multiple prongs for heating as taught by Dai.

In the appeal brief filed on November 5, 2009, appellants pointed out that multiple prongs (i.e., three sets of six arrows pointing downward) shown in figure 1B of Dai has nothing to do with radiating energy. Rather, the three sets of multiple arrows pointing downward indicate the direction of carbon containing gas distribution from the gas conduit. Figure 1B of Dai is again shown below (with comments in bubbles added by appellants).

Figure 1B .



In response, the examiner modifies or clarifies her position and states that that “Dai et al. discloses growing multiple nanotubes (carbon fibers) using heated zones (8) and feed gas (9). Thus the localized heating zones and gas heat the substrates, in a radiating fashion, on which the nanotubes are formed (see figure 1B below). Thus *the feed gas ‘prongs’ (9) passing through a heat zone (8) will form multiple prongs of radiating energy.*” (Emphasis added). See page 10 of the examiner’s answer.

Appellants respectfully disagree with the examiner’s tortuous interpretation of figure 1B of Dai. Claim 1 recites, *inter alia*, “a radiating-energy source, *positioned above the stage* to locally heat the catalyst on at least one die via simultaneously emitted multiple prongs of

radiating energy . . .” In figure 1B of Dai, heating element (2) *is located below* the substrates (1), and is not “positioned above the stage” as recited in claim 1. The localized heating zones (8) merely refer to the top surfaces of the substrates (or their vicinity) which are heated by the heating element (2) from underneath the substrate.

The examiner appears to take the position that gas coming down from the gas distributor (9) absorbs heat while it reaches the top surface of the substrates. However, even if gas absorbs heat, it does not radiate energy to “locally heat the catalyst” as recited in claim 1. Thus, gas coming down from the gas distributor cannot be regarded as “simultaneously emitted multiple prongs of radiating energy” from a radiating-energy source, as alleged by the examiner.

Furthermore, the arrows shown in figure 1B are mere representation of direction of gas coming out from the gas distributor (9). Nowhere in Dai suggests that gas coming out from the gas distributor stays in the form of multiple prongs as alleged by the examiner. If the gas were to stay in the form of discrete, multiple prongs until it reaches the substrates, then discrete spots of nanotubes may form on substrates. However, there is no disclosure or suggestion for forming discrete spots of nanotubes in Dai. More likely, gas diffuses in the localized heating zones (8) as it reaches the top surfaces of the substrates.

On page 10 of the examiner’s answer, the examiner again states that “Figure 1B Dai et al. (WO 02/081366A1) shows localized heating zones (8) with multiple heating prongs *or laser beam prongs*.” As noted above, appellants respectfully disagree that arrows shown in Dai has anything to do with laser beam prongs. Further, obviousness cannot be established by modifying Dai’s “gas prongs” with “laser beam prongs.” If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). MPEP § 2143.01.

Here, if it is the position of the examiner that it would have been obvious to substitute so-called “gas prongs” with laser beam in Dai to make laser beam prongs, appellants submit that such a substitution would destroy the function of Dai. If “gas prongs” were replaced with laser beam prongs, then such a substitution would eliminate the feedstock gas delivery system of Dai and no nanotubes will be formed on the top surface of the substrates. Thus, one of ordinary skill in the art would not have substituted “gas prongs” with laser beam in Dai.

On pages 7–8 of the appeal brief filed November 5, 2009, the appellants stated that one of ordinary skill in the art would not have modified Colbert’s heating method in view of Dai. Colbert desires that “*the only* heat supplied for the growth reaction should be focused at the growing tip of the fiber.” (Emphasis added). See column 26, lines 35–42. On the other hand, Dai is concerned with providing homogenous heating of the substrate to grow nanotubes. See page 12, line 28. Thus, it is the position of the appellants that the Colbert’s approach of heating just a fiber tip is completely the opposite of Dai’s approach of homogeneously heating the entire substrate to grow nanotubes, and the references teach away from each other.

In response, the examiner states at pages 10–11 of the examiner’s answer that “if Colbert et al. grew more than one fiber there would have to be more than one heating source or supply. This is essentially the growth scenario in Dai et al. whereby multiple carbon nanotubes are grown and require multiple radiating energy prongs as shown in the above figure 1B.” Then the examiner concludes that “the multiple radiating energy prongs would not be counter intuitive in Colbert et al. if more than one carbon fiber was grown.”

Appellants respectfully disagree. As noted above, there is no teaching or suggestion of multiple radiating energy prongs in Dai. Furthermore, if Colbert’s laser 1006 shown in figure 10 focused at the growing end of the carbon fiber were to be split into multiple laser beams, then some of aligned carbon nanotubes on the array in Colbert (see, e.g., figure 8) may fall between multiple prongs of a split laser beam and will not receive required energy from laser beam. This would be an inefficient use of energy and carbon nanotubes, as some of the carbon nanotubes would not participate in the formation of a continuous carbon fiber. Thus, even if Dai were to teach multiple prongs of radiating energy, one of ordinary skill in the art would not have split Colbert’s focused laser into multiple beams in view of Dai.

For the above reasons and for the reasons stated in the appeal brief filed November 5, 2009, the cited references do not teach or suggest, *inter alia*, “a radiating-energy source, positioned above the stage to locally heat the catalyst on a least one die via simultaneously emitted multiple prongs of radiating energy” as recited in claim 1. Thus, the rejections are improper and should be withdrawn at least for this reason.

Page 12 of Examiner's Answer (III.2)

For III.2 (claims 11–12), the examiner's arguments are similar to the arguments given on previous pages of the office action dated March 20, 2009. Appellants' arguments for nonobviousness for claims 11–12 can be found on page 9 of the appeal brief filed November 5, 2009.

Pages 12–13 of Examiner's Answer (IV)

For IV (claims 4–5 and 10), the examiner states that “Dai et al. teaches multiple prongs of radiating energy and Colbert et al. discloses heat sources such as microwave energy, laser energy, RF energy, heated gas, heated feed gas and so forth. Thus the multiple prongs of radiating energy of Dai et al. could be laser beams as taught by Colbert et al.”

Appellants respectfully disagree. As described above and in the appeal brief, neither Colbert nor Dai teach or suggest “simultaneously emitted multiple prongs of radiating energy” from a radiating-energy source.

In addition, the examiner has not addressed appellants' arguments why one of ordinary skill in the art would have modified Colbert or Dai in view of Glasner-Inbari, when Glasner-Inbari describes the use of a beam splitter in the art of optical disk drives and optical scanning. Glasner-Inbari describes the use of a beam splitter so that the data transfer rate can be multiplied by the number of beams/detectors. See column 17, lines 28–31. Even if a beam splitter were “a common device” used in optical disk drives and optical scanning, as alleged by the examiner, this would not have led one of ordinary skill in the art to apply a beam splitter to either Colbert or Dai for the purpose of heating catalysts in the production of carbon nanotubes or fibers. Further, because Glasner-Inbari is so different from Colbert and Dai, it is nonanalogous art.

Pages 13 of Examiner's Answer (Grouping of V.1 through V.4)

The examiner states that she disagrees with the grouping of the claims, because claim 16 (in group V.2), claim 37 (in group V.3), and claim 38 (in group V.4) all depend on claims 15 or claim 29 (in group V.1).

As stated above, appellants submit that the dependency of claims is not a determining factor as to whether claims stand or fall together. Appellants have met the requirements of 37 C.F.R. § 1.965(c)(7) by providing a statement whether the claims of the group do not stand or

fall together and an explanation as to why the claims of the groups are believed to be separately patentable. See pages 11–14 of the appeal brief filed November 5, 2009.

Pages 13–14 of the Examiner’s Answer (V.1–V.4)

For V.1 (claims 15, 17, 29–36, and 39–46), the examiner states on page 6 of the examiner’s answer that “[a]lthough the system is used for carbon nanotube fabrication and temperature is disclosed, temperature control is not specifically taught.” Then the examiner relies on Hong and concludes that “[i]t would have been obvious to one skilled in the art to use feedstock gas delivery line temperature controller 500 of Hong et al. because this temperature level is critical to the reaction and hence it is required that i[t] be controlled.”

As noted on page 12 of the appeal brief, appellants again submit that the examiner’s reliance on Hong is misplaced. Hong describes that “[t]he temperature controller 500 measures the internal temperature of the reactor 100 using a thermocouple and the like, reads out the measured result and maintains the internal temperature such that a catalyst can be injected into the reactor 100 in gas phase.” See paragraph 31. Hong’s temperature controller 500 has nothing to do with a stage temperature-control unit. In fact, Hong does not even utilize a stage to place a support (i.e., a substrate), let alone teach or suggest using a stage temperature-control unit as recited in claim 15 or 29. Hong’s support 130 onto which catalyst 135 is loaded is the powder type, which is later introduced into a reactor in a boat. See paragraphs 32, 39, and 40 of Hong. One of ordinary skill in the art viewing Hong would not have modified Colbert’s or Dai’s stage to include Hong’s temperature controller 500, because Hong’s temperature controller has nothing to do with controlling the stage temperature.

Furthermore, none of the cited references, alone or in combination, teach or suggest two separate temperature controls, as recited in claim 29, where a temperature control unit, coupled to the stage, maintains the stage and the workpiece at a first temperature and a radiating energy source, above the stage, locally heating the catalyst of a selected work region to a second temperature, above the first temperature, via multiple prongs of radiating energy.

On page 14 of the examiner’s answer, the examiner further states that “[s]ince all the carbon fiber/nanotube fabrication is conducted within a closed reactor it is the position of the examiner that the temperature control of the gas or the substrate will all yield a relative constant workpiece temperature.”

Claims 15 and 29 recite that “the stage includes *a stage* temperature-control unit” and “a temperature control unit, coupled *to the stage*,” respectively. Appellants submit that whether or not the cited references use a closed reactor or maintain a relatively constant workpiece temperature, as alleged by the examiner, does not address the limitations of the claims. Appellants submit that one of ordinary skill in the art viewing Hong would have modified Colbert and Dai to include Hong’s temperature controller, when Hong does not describe using a stage or controlling the stage temperature.

For V.2 (claim 16), V.3 (claim 37), and V.4 (claim 38), the examiner has not addressed arguments presented on pages 12–14 of the appeal brief filed November 5, 2009. Appellants believe that each group of claim is separately patentable and the rejections are improper for the reasons provided in the appeal brief filed November 5, 2009.

Pages 14–15 of Examiner’s Answer (VI)

For VI (claims 47–49 and 52–55), the examiner’s arguments are similar to the arguments given on previous pages of the examiner’s answer. So, the appellants’ arguments presented above (group IV) are also applicable to these pages of the examiner’s answer. This group of claims should be allowable for at least the reasons discussed above in group IV and for the additional reasons discussed in other groups.

Page 15 of the Examiner’s Answer (VII)

Regarding claim 50, appellants acknowledge the examiner’s citation of a passage from Smalley at column 23, lines 1–17 which describes applying electric field to orient fibers in a direction substantially perpendicular to the wafer surface. However, there is no teaching or suggestion for placing an electric field generator “having an adjustable position relative to the stage,” as recited in claim 50. Further, appellants believe that claim 50, which depends upon claim 29, is unobvious for the reasons described above and in the appeal brief filed November 5, 2009.

Regarding claim 51, Smalley does not teach or suggest using a magnetic field generated by a magnetic generator to influence a direction of nanostructure growth in the selected work region. Also, there is no teaching or suggestion for placing a magnetic field generator “having an adjustable position relative to the stage,” as recited in claim 51. Further, claim 51, which depends

upon claim 29, is unobvious for the reasons described above and in the appeal brief filed November 5, 2009.

Conclusion

For the above reasons, appellants submit that the examiner's rejections of the claims should be withdrawn, and reversal of the examiner's decision is respectfully requested.

Respectfully submitted,

Aka Chan LLP

/Melvin D. Chan/

Melvin D. Chan
Reg. No. 39,626

Aka Chan LLP
900 Lafayette Street, Suite 710
Santa Clara, CA 95050
Tel: (408) 701-0035
Fax: (408) 608-1599
E-mail: mcl@akachanlaw.com